APPLICATION DEVELOPMENT TOOLS TREND

- Higher Proportion of End User Developed System
- More Business Driven Analysis
- More IS Control and Support
- Quality to Override Productivity
- Tool Integration to Increase
- AI Additives Become More Common

PRODUCTIVITY

PERFORMANCE!

PROBLEMS!

PLANNING!

PRESENTATION OUTLINE

I. Introduction

II. Market Overview

III. Study Findings

IV. Future Directions

V. Conclusions & Recommendations

OBJECTIVES

- Debunk Myths
- Define Problem
- Analyze "Solutions"
- Determine Requirements
- Provide Measurement Framework
- Make Recommendations

INSTANT MYTH DEBUNKING

- Shoemakers Children
- Hardware/Software Is Cheap
- Information Has Value
- Offices Can Be Automated
- AI Will Save Us

SCOPE AND USE

- Broad Perspection
- Hardware-Software Environment
- Data/Information/Knowledge
- Office Productivity
- Performance & Cost Justification
- Planning!

PERFORMANCE LEVELS

- Hardware - Software
- Human - Machine Dyad
- Work Unit
- Institutional

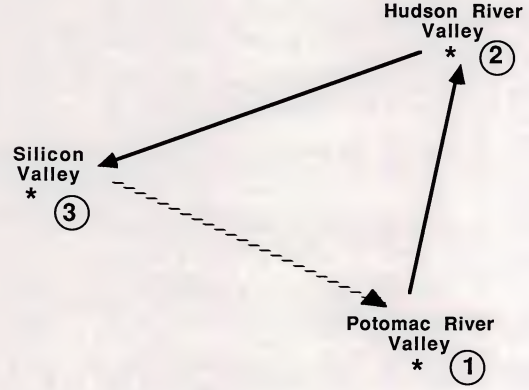
PRODUCTIVITY HIERARCHY

- Commitment to Quality
- End User Involvement
- Broad Based Management
- Effective Personnel
- Right Tools

METHODOLOGY

- Interviews
  - Senior IS Management
  - Industry Experts
  - Integrated ADS Users
- Case Studies
- Desk Research
- Analysis

PERSONAL CASE STUDY



RELATED INPUT REPORTS

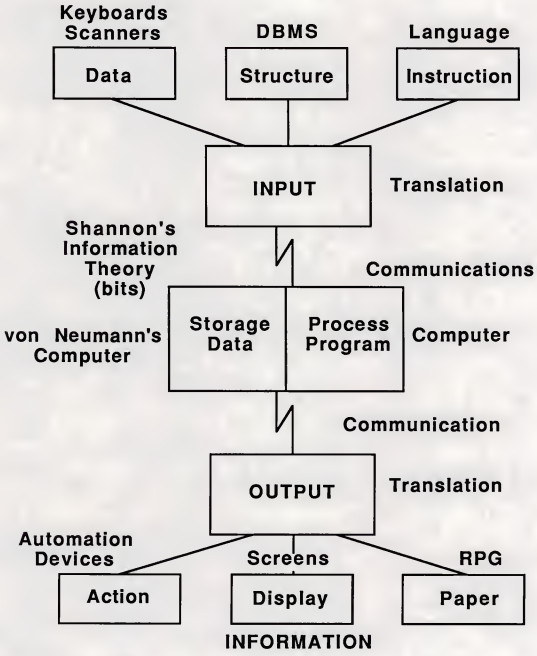
- "Systems and Software Productivity"
- "Software Development Productivity"
- "Impact of Office Systems on Productivty"
- "Relational Data Base Developments"
- "Market Implants of IBM Software Strategies"
- "Market Implants of New Software Productivity Techniques"
- "New Opportunities for Software Productivity Improvement"
- "Artificial Intelligence and Expert Systems"
- "Market Analysis: Data Base Management Systems"
- "Market Analysis: Fourth Generation Languages"
- "Market Analysis: Applications Development Tools"

MARKET OVERVIEW

DEFINING THE PROBLEM

- The Problem Defines the Market
- The Problem has Defied Solution
- Some Solutions Contribute to the Problem
- The Market Is:
  - Larger &
  - More Complex

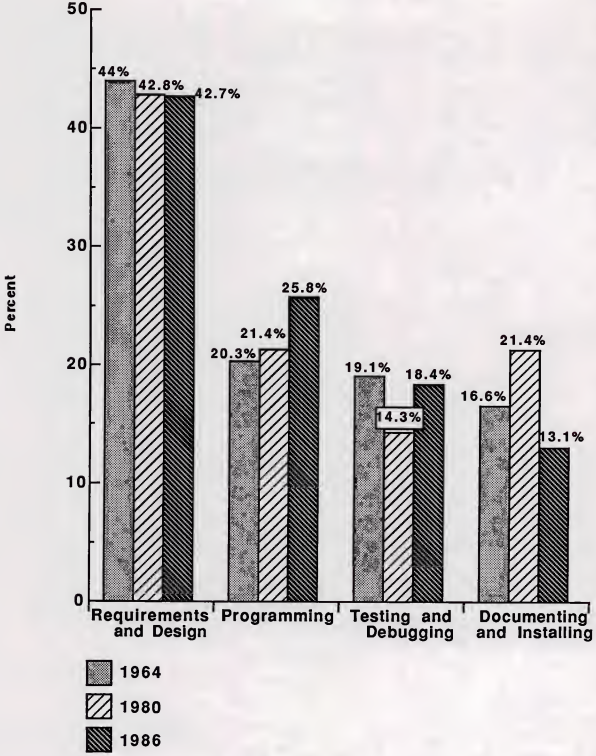
A SCHEMATIC FOR EVALUATION



TRENDS IN SOLUTIONS

- Languages
  - 4GLs
  - FGLs
- DBMS
  - Schemas
  - Relational
- Communications
  - Internal
  - External
- Integration of Above
- Action/Automation/AI

SOFTWARE DEVELOPMENT TIME DISTRIBUTION - 1964/1980/1986



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THE PRODUCTIVITY PYRAMID
1980

DISTRIBUTED SYSTEMS DEVELOPMENT (DSD)
1984

- Data Base Integrity
- File Syncronization
- Hardware-Software Performance
- Privacy and Security
- Auditability

MEASUREMENT AND MARKET SIZE

- Productivity Not Measured By Volume
- Markets Beyond Data Processing
- Information Flow
- Knowledge Workers
- Quality, Quality, Quality

STUDY FINDINGS

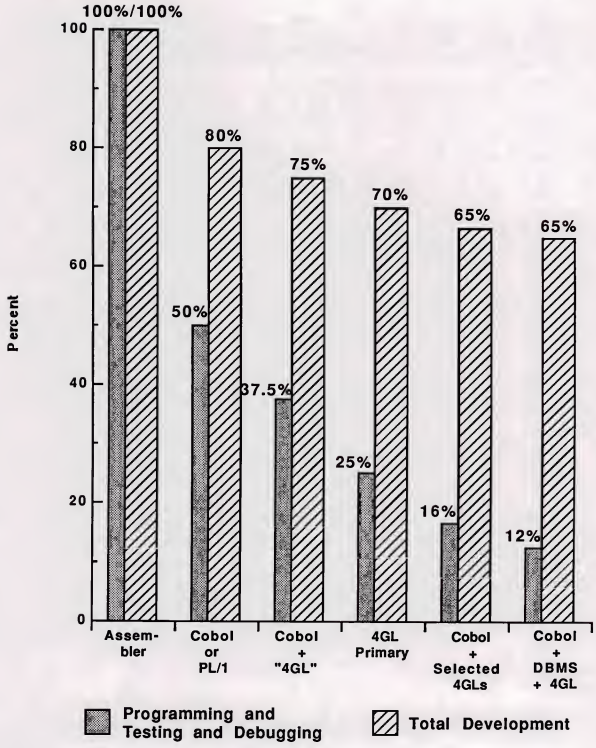
LANGUAGES

- Cobol - Primary Language (60%)
- Fortran & PL/1 (22%)
- 4GLs (10%)
- Old Controversies Live On
- A Highly Personal Issue

OPINIONS ON LANGUAGES

- Languages Depend on Applications and Individuals
- Generations Do Not Make Sense
- Natural Languages Are "Unnatural"
- Does Your Computer Have a Sense of Humor?

THE IMPACT OF LANGUAGES



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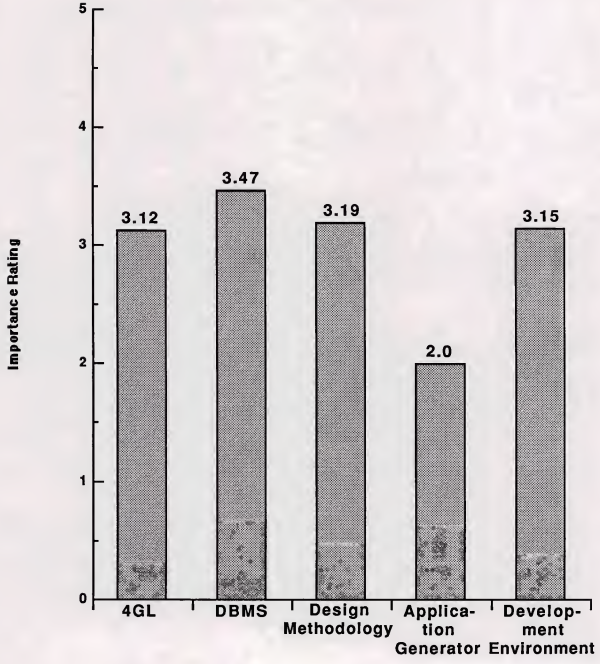
RATINGS OF IMPORTANCE OF PRODUCTIVITY TOOLS



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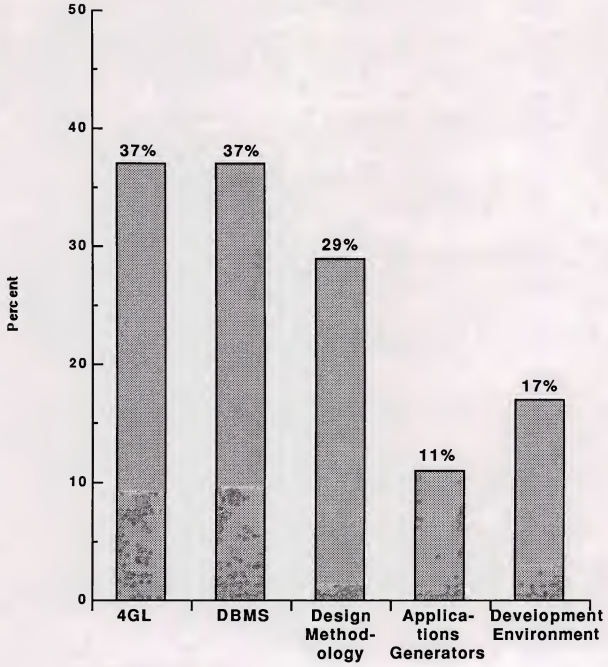
ESTIMATED SAVINGS
PRODUCTIVITY TOOLS



OPINION CONCERNING PERFORMANCE IMPROVEMENT (1960s and 1970s)

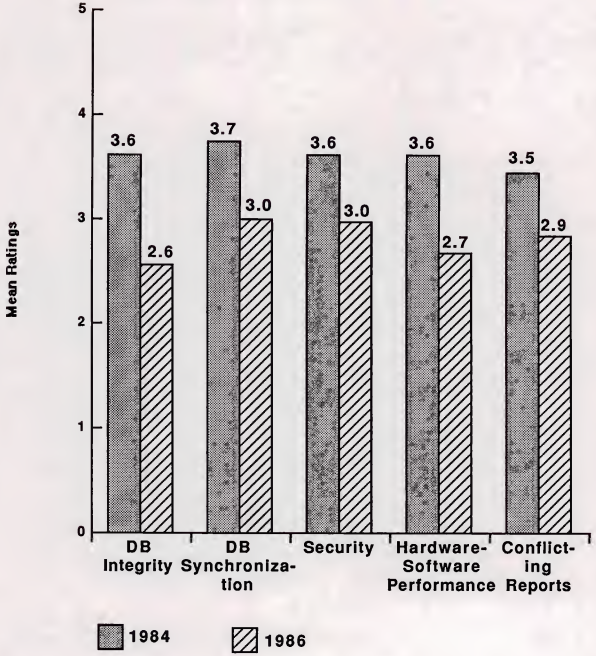
PERFORMANCE LEVEL	IMPACT*	
	1960s	1970s
Hardware - Software	-1	-2
Human - Machine Dyad	+2	+1
Work Units	+1	+1
Institutional	+1	0

* -2 = Strong Negative Impact
-1 = Some Negative Impact
0 = Neutral
+1 = Some Positive Impact
+2 = Strong Positive Impact

A FEW WORDS ABOUT DBMS

- The Relational Model Is Important
- Performance Eventually Becomes Important
- Other Models Will Remain
- There Are Unsolved Problems Associated with Distributed Data Bases

DSD PROBLEMS RATED
1984 AND 1986



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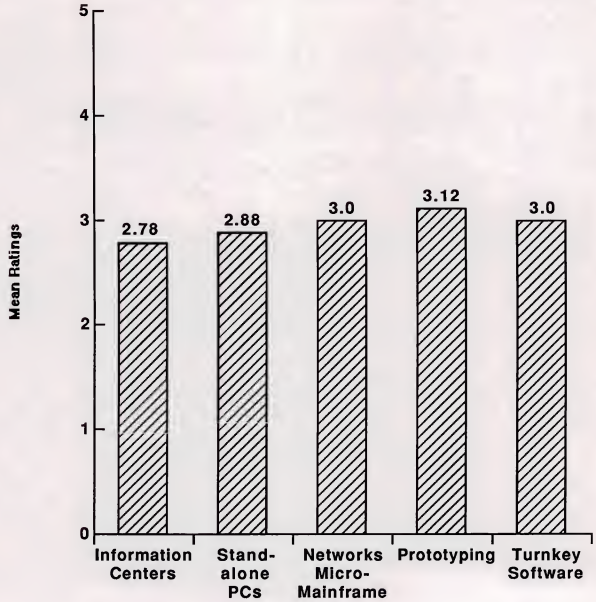
EFFECTIVE APPROACHES TO DSD



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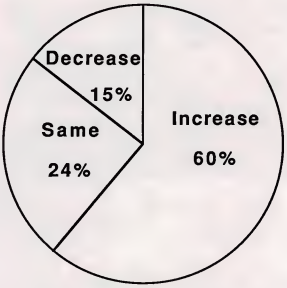
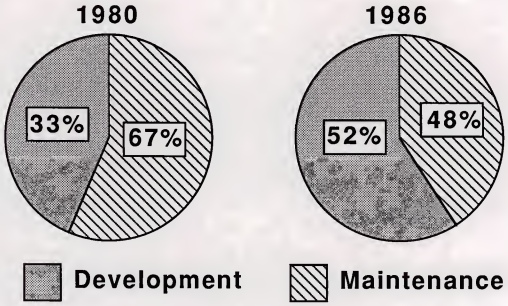
BACKLOG ANALYSIS (Since 1981)



MAINTENANCE (1980 and 1986)



PERFORMANCE IMPROVEMENT AND DSD

PERFORMANCE LEVEL	IMPACT OF DSD ENVIRONMENT	
	1960s	PROJECTED
Hardware - Software	-2	-2
Human - Machine Dyad	?	0
Work Units	?	11
Institutional	?	-1

* -2 = Strong Negative Impact
-1 = Some Negative Impact
0 = Neutral
+1 = Some Positive Impact
+2 = Strong Positive Impact

CASE STUDY # 1
(Financial Institution)

- IBM Oriented - Hardware, Systems Software, Network
- IMS, DB2, Teradata, and End User
- Analysis of Alternatives a Major Effort
- Hundreds of "Products" Reviewed and Installed
- Data Quality a Problem

CASE STUDY #2
(UNIVERSITY)

- Major Enhancements to Operating Environment
- Proprietary Software - DBMS and Languages
- Integrated Computer/Communications Network
- Office Systems Emphasis
- Questions Concerning Use
- "Team for Improving Productivity"

CASE STUDY #3
(Semiconductor Manufacturer)

- Concentration on Network
- Conversion of Manual Systems to Electronic
- Stated Objectives and Plan
- Pyramid Seems to Fall Naturally into Place
- Conventional Productivity Tools
- EDI

CASE STUDY #4
(Publishing Company)

- Major Converison of Tape Oriented Batch Systems
- Going IMS
- Using Knowledgeware
- Rejected Gamma
- Concerned About Performance
- Concerned About Flexibility

CASE STUDY #5
(Pharmaceutical Company)

- Considered "Information Engineering"
- Using Various Tools
- Maintenance and Enhancement Emphasized
- End User Involvement Stressed
- Professional and Pragmatic
- "Know Your Customers' Business"

FUTURE DIRECTIONS

INTEGRATED APPLICATIONS DEVELOPED SYSTEMS (IADS)

- No One Solution to Problem
- Mix and Match Doesn't Work Well
- Current Solutions Do Not Apply to Major Applications
- Need for Integrated Approach

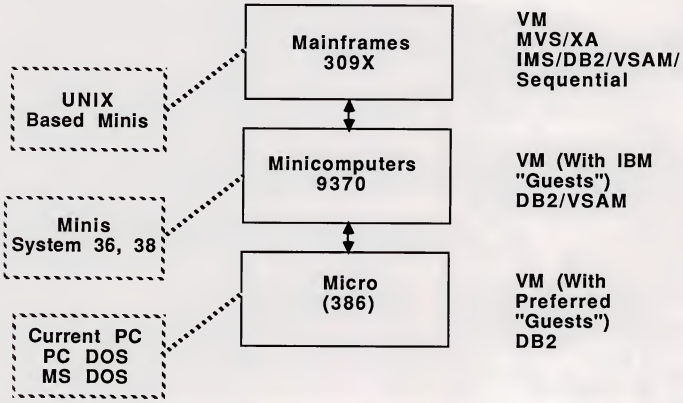
IADS ESSENTIALS

- Very High Level Language
- Meta (or Internal) Language → Various Targets
- Data and Screen Driven Reporting
- Communications Access → Various Targets
- Data Modeling → Various DBMS Targets
- Application System (Target) Independent of Development System
- Development System Capable of Addressing All Phases of Life Cycle
- Various Target Operating Environments

EMERGING IADS

- APS (Advanced Programming System) from Sage Systems
- Gamma (With Knowledgeware) from Tarkenton
- Pacbase From CGI Systems, Inc.
- Telon from Pansophic Systems, Inc.
- Transform from Transform Logic, Inc.

IBM'S PREFERRED SOLUTION



IBM ENDORSED DDP
(Network Evolution)

- 9370 the Preferred Environment
- Evolution Still the Strategy, But Pieces Are in Place
- Three Tiered Approach Finally Endorsed
- Networks First and Then "Hang on Computers" Unlikely
- Need for IADS within the IBM Environment

MEDIA REVOLUTION

- Our Tools Are Creating the Paper Problem
- CD ROM Only the Tip of the Iceberg
- A Fundamental Media Change with More Far-reaching Impacts than the PC
- Beware the Lovelace Cycle
- New Tools and Systems Concepts Necessary
- Information Flow Control Possible
- Intelligent Documents

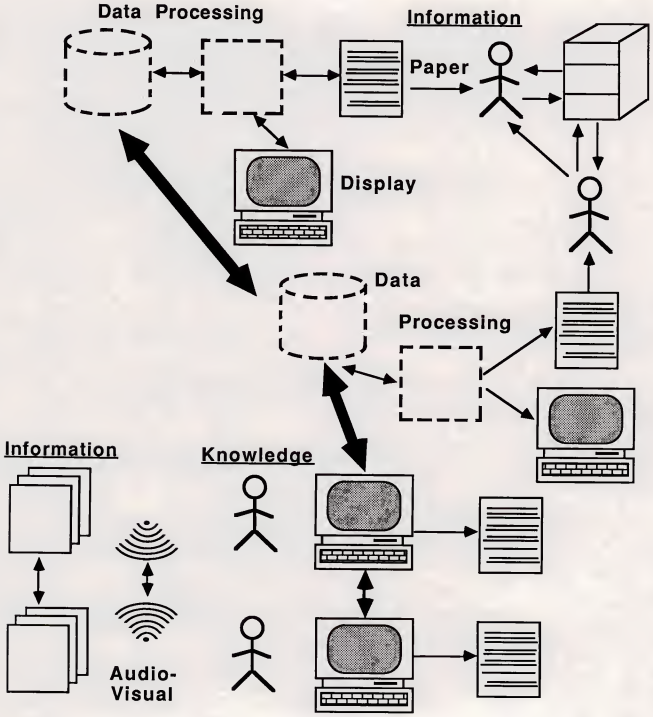
AI AND ALL THAT

- Expert Systems Are Not Going to Solve the Systems Development Problem
- Domains Are Too Narrow for General Purpose Problem Solving
- Programmers Are Not Going to Disappear
- Knowledge Base ◄► Data Base Connection
- AI ◄► Or Links Needed
- Knowledge Engineering Merely Thorough Systems Analysis
- T^3

THE BRIGHT SIDE OF AI

- Information Flow Control Monitors
- Expert "Readers"
- Information Analysis and Classification
- Knowledge Identification

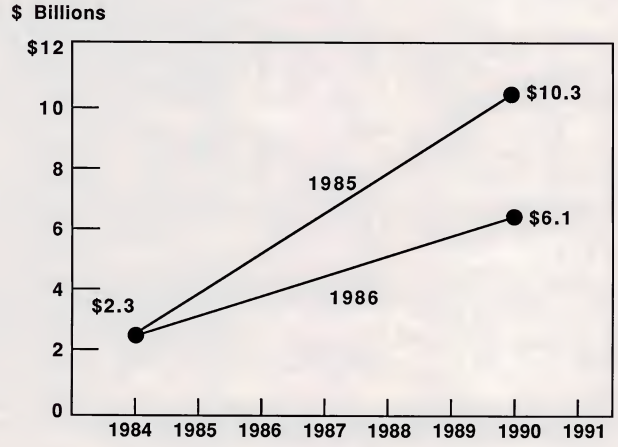
THE DATA/INFORMATION/KNOWLEDGE MODEL



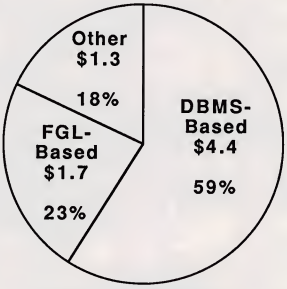
FUTURE EXPECTATIONS

Performance Level	Commitment To Quality	End User Involvement	Broad-Based Management	Effective Personnel	Right Tools
Hardware-Software	1				7
Human-Machine Dyad		2			12
Work Unit	1	3		4	5
Institutional	2				
Total	3	5	0	4	24

FORECAST ADTS

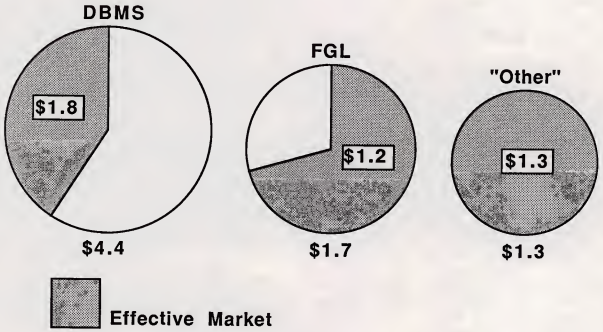


ADT FORECAST, 1991
($ Billions)

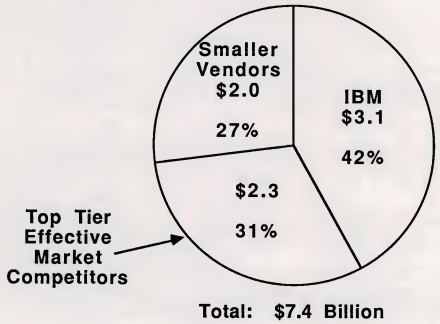


Total: $7.4 Billion

EFFECTIVE MARKETS, 1991
($ Billions)



MARKET SHARE, 1991
($ Billions)



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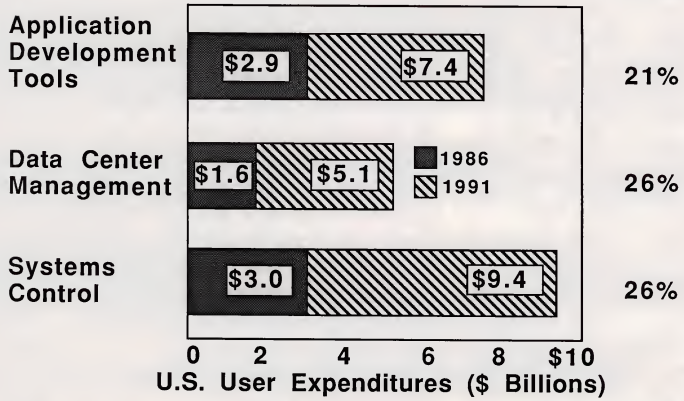
STRATEGIC MARKET ANALYSIS

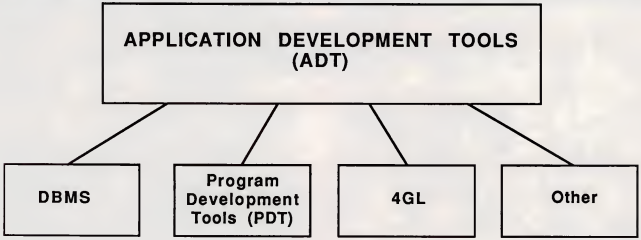
- IBM Sets Environment and Gets Its Share
- Smaller Companies Develop Innovative Products
- Growth Presents Problems
- Top Tier Will Face Software Productivity Problems

INPUT®

APPLICATION DEVELOPMENT TOOLS INDUSTRY DIRECTIONS AND FORECASTS, U.S.

TOTAL SYSTEMS SOFTWARE MARKET BY SOFTWARE TYPE, 1986-1991



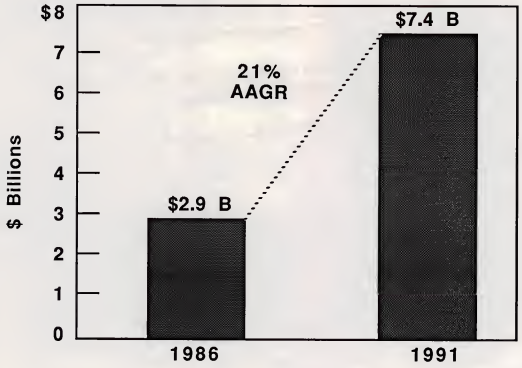


- DBMS
- Data/Dictionaries

- Application Generators
- Automatic Documentation
- Debugging Aids
- Conversion Tools
- Translators
- Retrieval Systems
- System Library Control
- Other

- Languages
  - Compilers
  - Assemblers
- Other

APPLICATION DEVELOPMENT TOOLS
1986-1991



APPLICATION DEVELOPMENT TOOLS DRIVING FORCES

\+ Commitment to Competitive Edge Systems

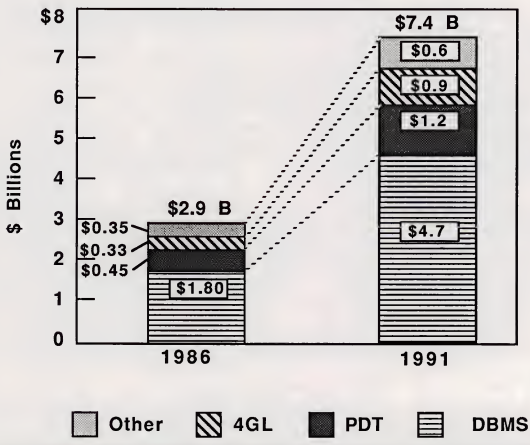
\+ Central Role of Connectivity

\+ - IBM Emphasis on Account Control

\- Increasing Appeal of Application Software Products

\+ Popularity of 80386-based Micro

APPLICATION DEVELOPMENT TOOLS BY SEGMENT, 1986-1991



AAGR

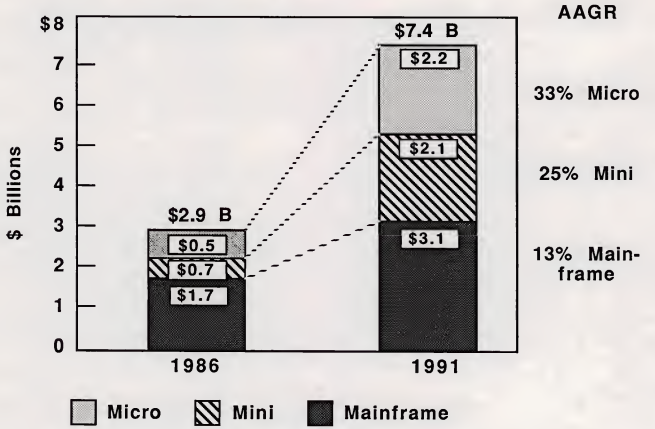
23% Other

23% 4GL

22% PDT

21% DBMS

APPLICATION DEVELOPMENT TOOLS BY SYSTEM TYPE, 1986-1991



APPLICATION DEVELOPMENT TOOLS TRENDS

- Higher Proportion of End User Developed Systems
- More Business Driven Analysis
- More IS Control and Support
- Quality to Override Productivity
- Tool Integration to Increase
- AI Additives Become More Common

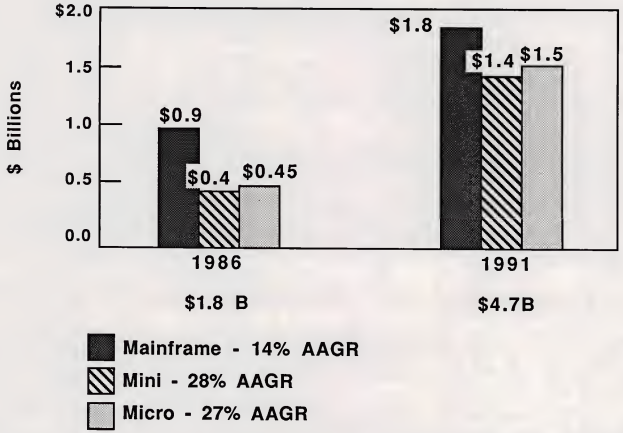
APPLICATION DEVELOPMENT TOOLS ISSUES

- Degree of IS Control
- Extent of Standardization
- Level of Interfacing Required
- Scope and Complexity of End User Developed Systems
- Viability of Distributed DBMS

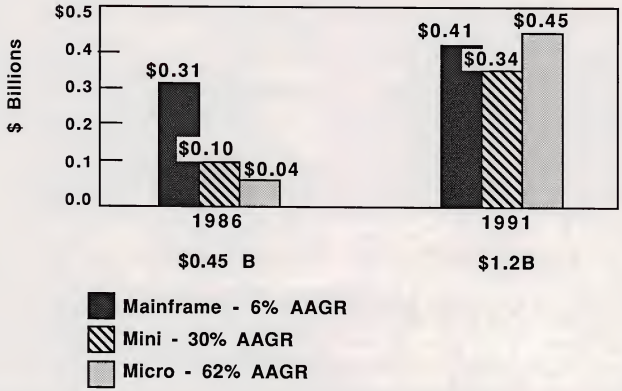
DBMS TRENDS

- Technology ⟶ Relational
- Viability of Relational for Production Data Bases
- SQL Standard
- Expanding Role of Data Dictionary

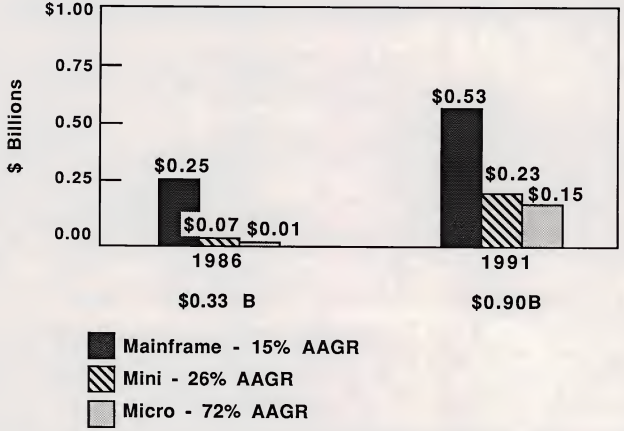
DBMS - BY SYSTEM TYPE
1986-1991



PROGRAM DEVELOPMENT TOOLS (PDT) BY SYSTEM TYPE 1986-1991



4GL - BY SYSTEM TYPE
1986-1991



IBM ADT REVENUES

	1986 ($ Millions)	1991 ($ Millions)	AAGR
DBMS Total	$575	$1,900	19%
- IMS	500	400	-4%
- DB2/SQLDS	75	1,400	68%
PDT (CSP,AS, etc.)	150	525	28%
4GL	25	150	43%
Other	100	220	17%
Total	$850	$2,295	22%

U.S. DBMS MARKET LEADERS
1986 USER EXPENDITURES

IBM	575
ASHTON TATE	200*
DEC	100
CULLINET	81
COMPUTER ASSOCIATES INTERNATIONAL	63
ORACLE	60
ADR	54
CINCOM	40
DATA GENERAL	40
UNISYS (SPERRY/BURROUGHS)	40
SOFTWARE AG	39
HEWLETT-PACKARD	35

* Distribution Channel Markup Included

U.S. 4GL MARKET LEADERS
1986 USER EXPENDITURES
($ Millions)

Information Builders	**70**
Dun & Bradstreet	**55**
On-Line Software*	**40**
ADR	**32**
Cullinet	**22**
Software AG	**20**
Cincom	**18**

*Acquired from Martin Marietta

U.S. APPLICATION DEVELOPMENT SYSTEMS MARKET LEADERS 1986 USER EXPENDITURES ($ Millions)

IBM	150
Pansophic	75
ADR	18
Cullinet	15
Computer Associates	8
Software AG	6

CONCLUSIONS

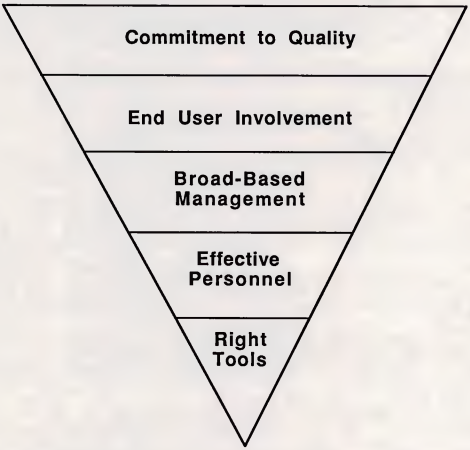
- All ADT Segments Healthy
- End Users Assume More of System Development Responsibility
- IBM Key Market Player
- Integration of Tools

CONCLUSIONS AND RECOMMENDATIONS

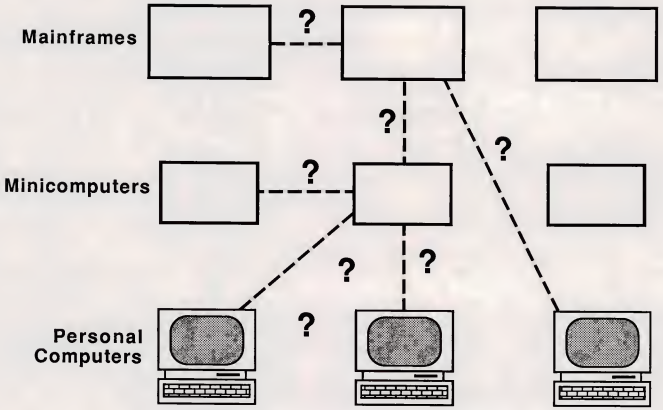
SOFTWARE PRODUCTIVITY
UPS, DOWN, AND QUESTIONS

- Quality and Variety of Productivity Tools
- Use of Productivity Tools
- Confusion
- Misuse of Productivity Tools
- Performance
  - Hardware - Software (Mainframe)
  - Human - Machine Dyad
  - Work Unit
  - Institutional
- Forecasts
- Why

THE PRODUCTIVITY PYRAMID 1980



BACKWARDS



PRODUCTIVITY PLAN

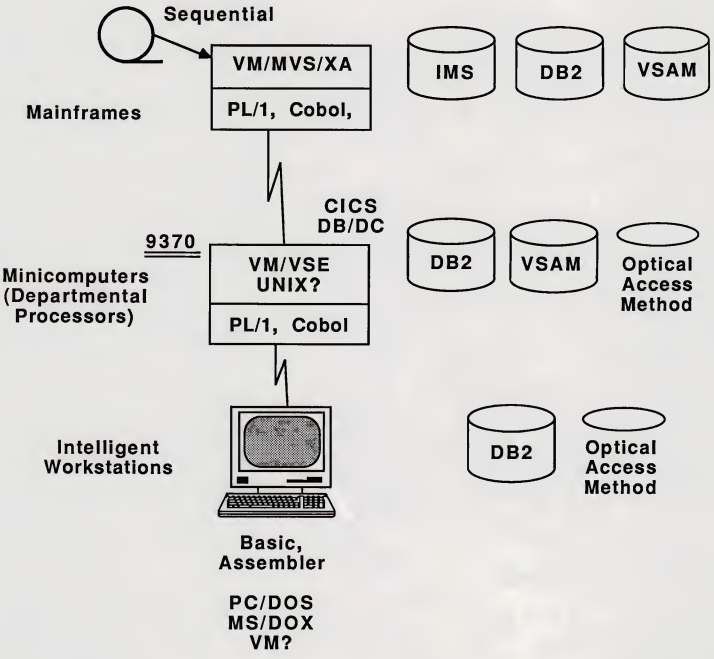
- **Commitment to Quality**
  - Hardware-Software
  - Human-Machine Dyad
  - Work Unit
  - Institutional
- **End User Involvement**
  - The Right Tools
  - User Requirements*
- **Broad-Based Management**
- **Effective Personnel**
- **Use Tools**

REQUIREMENTS BY PERFORMANCE LEVEL

- **Hardware-Software** → Network Management
  Performance Management
  Privacy and Security
- **Human-Machine Dyad** → Expert Systems
  Knowledge Base
  Management
- **Work Unit** → Document Control
  Information Flow
  Media Replacement
  (Paper → Electronic)
- **Institutional** → Data/Information/Knowledge
  - Content
  - Integrity
  - Flexibility

  Improved Modeling

IADS NOT MAGIC, BUT . . .



RECOMMENDED CHANGES OF DIRECTION

- Data Processing → Information Flow
- Information Quantity → Information Quality
- Automation of Process → Improved Process
- Information Emphasis → Knowledge Emphasis
- Tool & Application Builders → D/I/K Architects
- Vendors & Systems Developers → Productivity Consultants